

mercury, whose temperature is 32° F. Consequently a pressure of 30 standard inches corresponds to a weight under standard gravity of 14.718 pounds to the square inch. If measurements by the mercurial barometer are always corrected for the variations of gravity, and then converted by means of this latter constant factor, we shall obtain true pressures in pounds per square inch that are directly comparable with each other, no matter where the barometer may be located.

NOTES FROM THE JULY REPORTS OF THE CLIMATE AND CROP SECTIONS.

ARIZONA.

This is one of the most interesting States from a meteorological point of view. For many years the low pressure during the summer months was a conundrum that seemed impossible of explanation, but now we have every reason to believe that Arizona must be regarded as lying at the northern extremity of a narrow region of low pressure that extends from the equatorial Pacific northward over the Gulf of California; as soon as this was made clear it was seen that the low pressure in the summer at Yuma was not a local statical phenomenon but a part of the general feature due to the dynamics of the atmosphere, and depending, therefore, upon the winds and upper currents in the air. As this area of low pressure shifts its position slightly there occur local storms, but both the shifts and the local storms must be considered as the results of atmospheric changes going on at a considerable distance. For instance, on July 13-14 pressure was low in Arizona and the Gulf of California, while it was high on the coasts of California and Oregon. These conditions resulted in cloud-bursts and other local storms reported on the 15th and the wind and sand storms with light rain on the 16th. In general a flow of air southward through Arizona means a descent from high plateaus to sea level, which usually brings warm, dry clear weather to the lowlands. The present month, however, was normal as to temperature, with rainfall slightly in excess.

GEORGIA.

On the 1st at Marietta heavy thunder came from an almost cloudless sky, then a small cloud appeared and in ten minutes hail was falling. This is a pretty illustration of the origin and growth of local storms. One can scarcely doubt but that this small cloud grew in ten minutes to be a large one by virtue of the rapid ascension of a large mass of air, and the equally rapid descent of a similar mass in some neighboring region.

A similar purely local storm occurred on the 23d at Atlanta, where 4.32 inches fell in two hours, and half of that in forty minutes. The storm was purely local, so that points a mile or two from the city had comparatively little rain. Although the storm is said to have moved from southwest to northeast, yet, it would seem from this to have scarcely moved at all. In fact there are so many similar cases on record that one can not doubt but that very often a mass of moist air ascending nearly vertically carries up not only the moisture that is to be condensed and fall as rain, but an additional mass that ascends a little farther, then overflows and subsequently descends as dry air. It may be difficult to explain why such a stream of ascending air should remain within a mile or two of being stationary for two hours but, in general, we may say that under areas of high pressure the general horizontal movement is so gentle that if a mass of moist air once acquires a decided tendency to rise there is no special reason why it should not ascend vertically followed by other air in the same line of flow and constitute a complete vertical circulation of ascent and descent. A remarkable illustration of this same character occurred in August, at Washington, D.C.

ILLINOIS.

But twelve stations reported more than 2 inches of rainfall on any one day during the month and those mostly in the southern districts, therefore, when Elgin reports a very violent thunderstorm on the evening of the 19th, with some symptoms of a tornado, and yet measured only 0.043 inches of rain, we are constrained to note that the expression "very violent thunderstorm" seems to us rather misleading. The prominent characteristics of the thunderstorm may be either lightning, thunder, wind, hail, one or all of these. It would be more precise if one could make the entry read thus: "Storm with violent wind," or "with heavy rain," or "with excessive lightning and thunder." The International system of symbols could also be applied with clearness and economy of space, thus: "Storm on the 19th., lightning², thunder², rain⁰, hail⁰, wind¹." Here we have all the meteorological phenomena briefly recorded with as much accuracy as is ordinarily called for. (See the International Meteorological Symbols on page 311, of this number of the MONTHLY WEATHER REVIEW.)

IOWA.

An extraordinary rainfall, continuing three hours and amounting to 12 or 13 inches, is reported at Blanchard, on July 6. Blanchard is in Page County, in the southwestern corner of the State, and this record harmonizes with the report from Missouri for the same afternoon and evening, except only that the highest measurement was 8.15. There seems to have been a tendency to very heavy rain west of Iowa and Missouri in Nebraska and Kansas, as shown by the morning weather map of that date. The surface winds had been flowing from the southeast for two days and the general features of the maps for July 6-7 illustrate a principle that has been remarked ever since the first summer of study of the daily weather map, namely, that the flow of air from the south and east can not carry moisture up the western plains to a height of 1,000, 2,000, or 3,000 feet without being followed by severe local rains in the eastern portions of Indian Territory, Kansas, and Nebraska, and the western portions of Arkansas, Missouri, and Iowa. Somewhere in its gentle ascent this air must flow over on itself, which overflow is stimulated by the sun's action in heating the ground and lower stratum of air.

The Iowa reports are always full of interesting reading matter. We note among other things a short extract from Mr. E. J. Prindle's article on weather forecasts, who says: "The first attempt at scientific forecasting of the weather was the result of a storm which during the Crimean war, November 14, 1854, almost destroyed the fleets of France and England." The Editor may remark that the distinguished French astronomer, Leverrier, gives some account of the inauguration of daily telegraphic bulletins and weather predictions in France in the historical introduction to the first volume of his Atlas of the General Movements of the Atmosphere. In 1854 he was one of the most active astronomers of the world, but at that time the Paris Observatory busied itself only with its own local meteorological observations as a single station. It was Leverrier who noticed the apparent bodily movement of the storm in the neighborhood of the Crimea, in November, 1854, and who spoke of it to the Minister of War, Marshall Vaillant, thereby leading the latter to ask him, as the foremost scientist of the French Government, to investigate that storm, and eventually to organize at the observatory a bureau for the collection of weather telegrams and the prediction of storms. In February, 1855, Leverrier submitted definite proposals for this object, and his system of daily bulletins for French stations only, began in 1856. In 1858 this bulletin assumed the form of a regular publication, and was eventually extended so as to cover the whole of Europe, and became the Bulletin International. A first

weather prediction was attempted by Leverrier in April, 1857, and regular storm warnings for French ports, in 1859. The publication of the Bulletin was soon transferred to the meteorological observatory at Montsouris, under Marie-Davy, and subsequently to the Central Meteorological Bureau, under Mascart, as at present. In 1859 Elie de Beaumont writes that he found the International Bulletin very useful for weather predictions, and Leverrier began his warning dispatches to French ports when storms were apprehended. Regular weather predictions began to be published in the Bulletin August 12, 1863. They were called "probabilities," and were signed by Marie-Davy; but after a while they began to be signed alternately by G. Rayet and E. Fron. The daily weather chart to accompany the Bulletin began with the issue of September 12, 1863.

It is very evident to the careful historian that this great work of Leverrier is not the beginning of the history of modern weather telegraphy and predictions. For many years previous to his work the subject had been thoroughly canvassed in the United States. Leverrier only carried out in Europe the earlier ideas of the Americans, Espy, Redfield, and Henry. From 1849 to 1860, the latter carried on telegraphy, maps, and predictions at Washington, but without the assistance of government patronage. The history of Glaisher's work in London, 1849-51, has been given in the MONTHLY WEATHER REVIEW, 1897, pp. 205-206. Fitzroy began his storm signals in England in 1860, and Buys-Ballot in Holland in 1861. All these cooperated with Leverrier in developing this branch of practical meteorology, but Leverrier was really the third or fourth to enter the field, although he was the first to obtain support from any national government.

The current Iowa report describes a case of ball lightning on July 27, at Keokuk. While a distant thunderstorm was still at an hour's distance a ball of fire descended almost perpendicularly, leaving no illuminated path, and accompanied by a sharp report like that of a rifle, several large sparks seemed to fall slowly in the vicinity where the ball struck. Persons in the house at the time received no shock, although one sat within 6 feet of the spot where one of the weaker discharges struck.

MARYLAND AND DELAWARE.

The record of thunderstorms is very full. The Editor has a special interest in some very local storms that occurred on the 19th and 20th. From the Section Report we perceive that thunderstorms were recorded on that day at 22 stations out of the 32 that are quoted in the thunderstorm records. From the table of rainfall on each day of the month we see that rain fell at every station for the day ending 8 a. m. of the 19th, and at two-thirds of the stations during the subsequent twenty-four hours. The history of individual thunderstorms and the paths of local rains from individual cumulus clouds can not be written with any certainty until we have a network of rainfall stations less than five miles apart, or at least 400 for Maryland alone. The extremely local character of our heaviest wind and rainstorms in the summer time is shown by the fact that on the 20th, at about 1:20 a. m., a heavy cloud with a flood of rain and an 80-mile wind passed over Boyds station, in Maryland (about 30 miles northeast of Washington, D. C.) destroying telegraph and telephone poles, trees, and crops. The storm lasted for about twenty minutes and then passed on, disappearing in a portion of Montgomery and Howard counties, where there are no telegraph or telephone stations within a region of 50 by 20 miles. Nothing was seen of this storm at Beltsville, 12 miles from Washington, but there was a temporary cloudiness and threatening weather for an hour or two, just as there was at Washington itself. The Editor has been unable to

obtain any further records of this particular storm, and this fact forces one to be very cautious in expressing a confident hope as to the success of local storm predictions for the city of Washington. The telegraph and telephone stations northwest and southwest of the city are not so well distributed for forecasting local storms as would seem to be desirable; but a few additional stations, such as may be expected in a few years will, undoubtedly remedy this difficulty. Baltimore is not much more favorably situated in this respect. Meanwhile, and as preparatory to such predictions, it behooves us to plot and study the paths of as many local storms as we can, confident that the knowledge thus acquired will soon find an important application.

MONTANA.

On the 17th, near Martinsdale, in Meagher County, "at 6 p. m., a horse was killed by lightning from an almost cloudless sky while feeding on the flat bottom land, and no other object near; at the same time a heavy shower occurred 6 miles to the west." Such cases as this illustrate several points, two of which we will refer to. (1) The shower 6 miles distant, and the cloud from which it fell were attended by what is called an electrical disturbance. In fact, such disturbances may occur without a shower or a cloud, but this is rare. The electric disturbance affects the atmosphere to a considerable distance; for instance, flashes flow from the lower end of a kite wire in response to every lightning flash 50 miles away, and a crackling noise is heard in the telephone when the thunderstorm is beyond the horizon. One may often see a flash emanate from a cloud near the center of a storm, while other flashes simultaneously dart from the farther end of the same cloud toward the ground far away. (2) In general, we must recognize that the electrical disturbance extends to a great distance on all sides of a storm, and at present it is idle to attempt to explain why one object rather than another is struck by the flash, or to maintain that one locality is safer than another. As this case is that of a horse feeding on the flat bottom land, we may, perhaps, be justified in imagining that he himself was the only object that rose above the uniform level of the plain, and that this fact made him peculiarly liable to be struck. This is the reasoning in accordance with which men are urged not to take shelter beneath a tree in an open field when a thunderstorm is approaching. It is also on this principle that a sharp-pointed lightning rod, erected in the middle of a field, should serve as a path for the flash and thus protect animals and men.

NEW ENGLAND.

The reproduction of Dr. Frankland's theory of the dry fog as published in January, 1879, Vol. XXVIII, p. 238 of the Proceedings of the Royal Society of London (not the Royal Meteorological Society) calls for a word of explanation. The students of capillarity or surface tension, and its relation to evaporation have shown long since that minute globules of water do not readily part with their moisture, so that the air about them may remain dry for a long time, much longer than if the air was in contact with a flat surface. It is not necessary to explain ordinary dry fogs on any other physical principle except this. On the other hand, if one wishes to adopt Frankland's hypothesis that an oily film coats every fog particle he should find some means of demonstrating that this is the fact. It is true that by special laboratory methods fog particles of this kind may be manufactured; but it is very doubtful whether they exist in natural atmospheric fogs. However, the matter can easily be decided in our smoky cities if observers will collect the mass of fog particles by forcing the foggy air to bubble through a vessel of clean water, which latter would thus soon become coated with a visible oily film. Dr. Frankland says that the oily film has a strong tendency to leave the drop and attach itself to the solid support, leav-

ing the surface of the water partially unprotected. This shows that the surface tension of the oily liquid is much less than that of the water. If aqueous vapor should begin to condense upon a minute drop of oil as a nucleus, then, at some time in the history of the growth of the drop, the oil should escape from the center and become the surface film of the drop and retard its future growth as a drop of water. This whole subject lends itself to a beautiful series of experiments, such as might be carried on by the students of physics in the well equipped laboratories that are now so common in our universities and agricultural experiment stations.

NEW JERSEY.

A heavy thunderstorm and a disastrous stroke of lightning by which 5 men were killed and 3 were seriously injured occurred on Tuesday afternoon, July 19, near Boonton. It seems that the party took refuge under a tree on the banks of the Rockaway River. The Boonton Bulletin remarks:

Notwithstanding the many warnings about seeking shelter under trees during thunderstorms, many persons when caught out in a storm run to the trees. We regret to say that this fearful catastrophe is another illustration of the thoughtlessness of people under such circumstances.

Is not this too severe an arraignment? Doubtless the unfortunate men had heard that trees were dangerous but where else could they flee from the the storm? If they had sat upright in their boat anchored on the river, they would, like the poor horse in Dakota, have been as it were a projection above the plane of the water surface and, therefore, especially liable to be struck. Had they walked farther up the river banks beyond the trees, with umbrellas over their heads and fishing poles in their hands, they would also have acted as lightning rods to attract the flash. Had they hastily erected a genuine lightning rod and then retreated a few feet from it, they might possibly have been safe. But except for this, we know of no way by which they could have insured their safety. We can not attribute their deaths to their own thoughtlessness; they ran from one danger only to run into another, and it is not for us to say that the very slight chance of being killed by lightning—which hangs over all of us at all times—need enter into consideration when we are trying to escape the greater peril of high wind, heavy rains, and hail.

NEW YORK.

All section reports for the month of July pay especial attention to the amount of damage by lightning which subject will be summed up exhaustively in the Annual Report of the Chief of the Weather Bureau. As the July report for New York could not be published in time for consultation by the Editor, Mr. R. G. Allen has kindly sent, in advance, the following item with regard to loss by lightning:

Voluntary observers and crop reporters in this section report that the thunderstorms in the different parts of this State, during July, were more violent than ever before known by the oldest citizens. They occurred on the 3d, 4th, 9th, 11th, 18th, 19th, 20th, 21st, 23d, 24th, 25th, 26th, 28th, and 29th. The amount of loss was unprecedented. The following is a brief summary of casualties:

Seventeen (17) houses struck, total loss, \$1,138; thirty-seven (37) barns burned, total loss, \$44,536; value of stock killed by lightning amounted to \$2,190; four (4) churches were struck, and were injured to

the extent of \$600; a large planing mill at Moira was burned with a loss of \$12,000; the Stephenson Brewing Company at Oswego was struck by lightning and burned, the loss being \$150,000; sum of all losses reported to the Ithaca office was \$210,464. It is a noticeable fact that nearly all of the barns burned contained grain or hay, or both.

The distribution of this destruction on different days of the month was as follows:

Date.	No. of localities.	Value of property destroyed.
July 3...	4	\$3,450
4...	1	1,000
11...	1	130
18...	6	17,611
19...	9	158,770
20...	1	100
21...	5	1,380
23...	14	15,038
24...	1	250
25...	9	6,860
26...	3	3,670
28...	5	2,080
29...	2	125
Total.....		\$210,464

BRIGHT METEORS.

The Editor has recently received glowing accounts of something extraordinary in the way of aerolites or great meteors that are said to have fallen "in the back country up river," in June, in West Virginia. Parties are said to be out searching for some of the pieces, but the Editor fears that they will never be found. When a great meteor falls it is apt to be seen for a few seconds over a wide extent of country. This particular meteor was observed near Findlay, Ohio (N. 41° 3'; W. 83° 40'), and appeared to fall somewhere eastward. It is also reported from Point Pleasant, W. Va., on the Ohio River (N. 38° 50'; W. 82° 10'), where it appeared to fall somewhere back of Hawksnest; that is to say, still somewhat to the east. If these observations are reliable they simply point to the fact that a meteor passed eastward through the atmosphere on June 3, high enough up to be seen from distant points; but the detailed account about its actual fall to the ground must be a matter of imagination. Undoubtedly some meteors do reach the ground, but it is best not to describe such a fall until after the pieces have been found. Most of the bright meteors that seem to strike the ground beyond the distant horizon have actually been hundreds of miles distant, and are consumed in the air without striking the ground.

RECENT EARTHQUAKES.

No disturbances were reported during July from the seismoscopes of Professor Morley, Cleveland, Ohio, and Professor Marvin, Washington, D. C.

July 21.—Rivas, Nicaragua, slight shock at 11:55 p. m.

July 23–24.—Chile: During the night at Concepcion, and at Talcahuano, 8 miles distant, a violent shock lasting a minute and destroying many houses.

July 25.—New Hampshire: Concord and Canterbury, about 6 p. m.

METEOROLOGICAL TABLES AND CHARTS.

By A. J. HENRY, Chief of Division of Records and Meteorological Data.

Table I gives, for about 130 Weather Bureau stations making two observations daily and for about 20 others making only one observation, the data ordinarily needed for climatological studies, viz, the monthly mean pressure, the monthly means and extremes of temperature, the average conditions as to moisture, cloudiness, movement of the wind, and

the departures from normals in the case of pressure, temperature, and precipitation, the total depth of snowfall, and the mean wet-bulb temperatures. The altitudes of the instruments above ground are also given.

Table II gives, for about 2,700 stations occupied by voluntary observers, the highest maximum and the lowest minimum